wing-ribs and the rib-veins are yellow; the brands and the veins are brown, and the latter are very distinct.

1st var. The seventh joint of the feelers is hardly longer than the fourth.

2nd var. The mouth is dull yellow with a black tip.

3rd var. The nectaries are one-tenth of the length of the body.

4th var. The legs are black: the base of the thighs is yellow in the fore-pair, and has a slight tinge of yellow in the rest.

The oviparous wingless female? The head, the underside, and sometimes the chest, and even the whole body, are red: the mouth is pale yellow with a black tip. Found in the autumn.

The winged male? Black, and very small: the abdomen is very dark green: the feelers are a little longer than the body: the mouth is dull yellow; its tip and the nectaries are black, and the latter are as long as one-sixth of the body: the legs are black; the base of the fore-thighs, and the shanks, except their tips, are dark yellow: the wings are nearly twice the length of the body; the wing-ribs are pale yellow. In the beginning of November.

Length of the body $\frac{1}{2}$–$\frac{3}{4}$ line; of the wings $1\frac{3}{4}$–$2\frac{1}{4}$ lines.

[To be continued.]

XXVIII.—*Notes on a species of* Hydra *found in the Northumberland Lakes.* By Albany Hancock, Esq.

[With two Plates.]

On visiting the Northumberland lakes last August for the purpose of prosecuting my inquiries respecting the freshwater Ascidian Polypes, I took a very beautiful *Hydra* abundantly in Bromley Lough. On a subsequent occasion numerous specimens of the same species were also obtained in Crag Lough. They were found associated with the various *Bryozoa* that inhabit these waters, adhering to the under side of stones that lie scattered by their margins, and in situations where there was neither mud nor vegetation. From the peculiar character of the locality, so different from that of the usual habitat of the *Hydræ*, I was induced to examine the specimens with great care, and find that they do not exactly agree with any of the known forms, though they come very near to *H. fusca*, of which they may probably prove to be a variety.

On removing from the water a stone to which these *Hydræ* are attached, they appear as irregular, minute, depressed globules of gelatine of a pale red flesh-colour, dispersed over the surface, sometimes in great numbers on one stone, but never crowded on each other. When placed in a bottle of water they soon become fixed to its sides, and spreading out their tentacles display them-

selves to great advantage. They are now seen to be very variable in form, Pl. VI. figs. 3, 4,—or rather that they have great command over it, contracting themselves until they are almost globular or vase-like, with the tentacles very short and swelled out in the centre; then, extending themselves, they become linear, much attenuated, and frequently half an inch long,—the tentacles, fig. 5, being very delicate, and tapering imperceptibly towards the extremity which is enlarged and rounded, forming a nodule or bulb of no great size, but quite visible to the naked eye. The polype, however, is usually much less extended, and is generally a little bulged in the centre; the tentacles are then somewhat longer than the body, but are shorter than it when the animal is fully stretched out. There are usually six tentacles, occasionally five, rarely seven; they are white, never coloured in the centre like the body, which, as already stated, is a red flesh-colour; it is also sometimes yellowish. The colouring, which is apparently much affected by exposure to light, depends on the granules that line the internal or digestive cavity, and is most intense near the mouth.

When in their native haunts, attached to the under side of stones, the *Hydræ* must be nearly in total darkness; but on being placed in a bottle they become exposed to the solar rays, and in the course of a few days are almost completely bleached. Supposing that this loss of colour was occasioned by the want of food, the specimens were supplied with animalcules; but their original hue was not in the least restored.

During the first week or ten days the captives added greatly to their number by gemmation, the buds sprouting from the lower portion of the body,—rarely more than one at a time. Afterwards the budding was much less frequent; and in about a month from the time they were taken, most of the specimens had perished. Two or three, figs. 1 & 2, more favourably placed than the rest, continued to live on for some time longer, and thrived well; but they changed considerably in appearance. A short way below the tentacles two tubercles, *a*, *a*, had developed themselves opposite to each other, and were in every respect symmetrical; and the body was considerably enlarged towards the lower extremity. In this state the animal had a pedunculate appearance, and I was quite at a loss to account for the change. These specimens belonged to the first batch procured in Bromley Lough. On visiting the lakes again, however, in September, and getting a fresh supply, nearly all the individuals exhibited the same appearances; the tubercles being invariably a little below the tentacles, though not always symmetrically placed; and occasionally they were three and even four in number: the swelling, too, on the lower part of the body varied in different specimens.

On placing one of them, Pl. VII. fig. 5, under the microscope, the tubercle was found to be vesicular, of a conical form, with the apex obtuse, and to resemble in texture the general surface of the animal: the basal portion contained an opake, rosy, granular body, *a*, of a glandular appearance, which completely filled the base of the tubercle; the apex, *b*, was pellucid, and on being attentively examined a crowd of very minute moving bodies were observed within it.

Whilst watching with great earnestness the motion of these mysterious bodies, all of a sudden the apex of the tubercle burst, and a great number of them, cloud-like, rushing into the surrounding fluid, dispersed in all directions. The rupture appeared to close again, and the apex was seen to be almost empty; but fresh bodies making their appearance the receptacle was soon as full as ever. I have seen the eruption of these corpuscles on several occasions, and have no doubt that it is a natural phænomenon;—not resulting from any artificial means,—certainly not from pressure, as the animals were always quite free. On examining these moving bodies, fig. 12, which are exceedingly minute, with $\frac{1}{8}$th of an inch object-glass, they were found to be of an elliptical form, and to resemble spermatozoa; tails, however, were not detected, though with a higher power it is not improbable that they may be found; for I could not satisfy myself of their non-existence.

The nature of these tubercles or sacs is a matter of much interest. They were discovered by Ehrenberg, and described by him as the male organ,—the moving bodies being considered spermatozoa. Though I have not seen the original memoir on the subject, I think there can be little doubt of the accuracy of this opinion. How else can we account for the constancy of the appearance of these sacs?—for their development at the time the eggs are being produced, as we shall afterwards see is the case?—for their being situated always on the same part of the animal?—for the contained gland-like body, and moving corpuscles?—for the eruption of these latter bodies, and for their resemblance to spermatozoa?

Having thus detected what I believed to be the male generative organ, I was anxious to watch the development of the egg, which appears to have been already described more than once; but as it has rarely been observed by British naturalists, I will venture to give my own remarks on the subject. The lower portion of the body, as before stated, is enlarged at the time when the male organ makes its appearance. On examining the enlargement, Pl. VI. figs. 1 & 2 *b*, *b*, carefully, it is found to be usually greater on one side than the other; here it is opake and of a pale rosy hue, notwithstanding that the animal is faded

under the effect of light. The opake swelling extends nearly round the body,—the margins being generally distinct. This is the nascent ovum, as it appears at first; it gradually increases in size, Pl. VII. fig. 1 *d'*, and ultimately becomes very protuberant, bulging the body excessively on one side: the egg at this time is confounded with its covering; but it, *d*, is soon seen as a rounded, somewhat flattened body contained within a transparent envelope, *e*, resembling the general surface of the body, of which it is apparently a continuation. This envelope, fig. 2 *b*, *b*, shortly opens at the highest point of the swelling, and the egg, *a*, gradually makes its way through the orifice, which as gradually enlarges until the egg, figs. 3 *b* & 4 *e*, is completely exposed, and rests, as it were, within the mouth of a shallow cup, figs. 3 *e*, *e*, & 4 *g*, the contracted envelope. The egg remains in this position for a day or sometimes longer, attached to the body of the parent by a short, thin pedicle, figs. 3 *d* & 4 *f*: the margins at first are generally undulated, as in fig. 4; afterwards the egg becomes almost completely globular. It is ultimately detached, and soon fixes itself to some foreign body. On watching one individual through the microscope, the egg was observed to separate from the parent, and to move slowly away. No ciliary action could be detected to account for the motion; but it assuredly passed out of the field of view as often as the instrument was adjusted: in another instance, however, no motion could be observed. The egg, Pl. VI. fig. 6, in the course of an hour or so became stationary, and several minute globules, *a*, *a*, *a*, which had been noticed sticking to it from the first, Pl. VII. fig. 3 *c*, *c*, enlarged, and others made their appearance: they soon assumed the character of delicate cells, fig. 7, filled with globular bodies with dark margins. These globules are probably composed of some tenacious mucus with which to glue the egg to any substance on which it may happen to settle. Soon after attachment these bodies disappear, and the egg, which is now perfectly circular, is seen to be surrounded by a narrow, transparent rim, indicating the presence of a distinct chorion; the under side of the egg being flattened, the upper side convex, opake and rosy as at first.

I have not been able to determine with precision how many eggs are produced by each polype, but certainly no great number, probably not more than three or four, and in some instances perhaps only one. On one occasion after the egg separated from the animal, the latter gradually dwindled in size and ultimately disappeared. Most frequently, however, the polype is not materially altered on giving birth to an egg; and occasionally two, Pl. VII. fig. 1 *d'*, *d*, are in process of development at the same time, generally from opposite sides, one being more advanced than the other.

The male organ is only developed at the time the eggs make their appearance. In August, shortly after the polypes were procured, they multiplied rapidly, as we have seen, by gemmation, and at this period none of the sacs containing spermatozoa were observed. It was not until they had ceased to propagate in this way, some time in September, that the male organ was developed, and it was always visible afterwards, though variable in size.

All the individuals apparently produce eggs, and all are alike provided with the spermatic sacs; at least the ovum in various stages of development and the male organ are seen at the same time in most specimens: it is not uncommon, however, to observe the male organ only, the egg probably having just left the body of the parent, though I do not recollect having seen the egg in process of development in individuals unprovided with the sperm-vesicles.

It is worthy of remark, that the buds sprout from the same part of the body in which the eggs are developed; but I have seen nothing to warrant the assertion that the ova after impregnation "sometimes are retained and then grow out like buds." Indeed it is probable that fecundation does not take place until the egg bursts through the integument, and is attached to the parent only by a delicate pedicle. This would appear more likely than that impregnation should be effected through the skin of the animal. Whilst watching an individual when the egg was about to separate from the parent, the sperm-vesicle was frequently brought, by the contractions of the body, almost in contact with the ovum; thus fecundation might very easily be effected, and at a moment, too, when from analogy it might be expected to take place: more observations, however, are required to settle this point.

I have also observed sperm-vesicles, Pl. VII. fig. 6, in *H. viridis*: in this species they are much smaller than in the specimens from the Northumberland lakes, and are generally two or three in number, near the anterior extremity of the body, but without symmetrical arrangement. They are irregularly conical, with the base wide, within which there is likewise a distinct glandular body of a green colour; the moving bodies are very numerous, and occupy, as in the other species, the transparent apex. The sperm-vesicles were noticed in *H. viridis* after it had ceased to bud, some time early in October.

The tentacles, Pls. VI. & VII. figs. 5, 7, of the flesh-coloured species are very rough and beautiful, exhibiting an imperfect spiral arrangement of the nodular enlargements. There are two kinds of vesicles immersed in the nodules, as have been described in some other species; one being much more numerous and smaller than the other. The former are for touch, the latter for

prehension, according to Corda, who appears to have examined these organs with great care, but whose description of one of them is erroneous in several respects: the original memoir, however, I have not seen. Neither have I had an opportunity of consulting Ehrenberg's account of the minute structure of the tentacles of these animals. The smaller vesicles, Pl. VII. fig. 7 *a*, and fig. 8, seem to agree with Corda's description as given in Johnston's 'British Zoophytes'; they are elliptical, being composed of an inner and outer sac, both very delicate, transparent and membranous. These bodies are placed with their long axis perpendicular to the surface of the nodule in which they are imbedded, and have a non-contractile hair-like process projecting from the external end.

The larger vesicles, fig. 7 *b*, are very complicated, and appear to have been only partially understood by Corda, though he had arrived at a full comprehension of their functions. They are not merely prehensile organs, but are undoubtedly also stinging instruments, as supposed by this naturalist, and are at least twice as large as those for touch: they, fig. 9, are of an ovate form, short and stout, immersed in the substance of the nodule with the narrow end uppermost, and immediately beneath the surface. At the bottom of the vesicle, which though perfectly transparent has rather thick walls, is seen a delicate lining membrane, *d*, folded down upon itself, having a cup- or saucer-like appearance. This, according to Corda, is "a saucer-like vesicle." Standing up from the centre of this is a transparent membranous stalk, *c*, irregularly bulged a little at the sides, and surmounted by a sharp arrow-like head, *b*, with the barbs much depressed. This supporting stalk is described by the naturalist just quoted as "a solid, ovate corpuscle." But to get a full knowledge of this apparatus, it must be examined when exserted and ready for action. The saucer-like vesicle is then seen to have disappeared, and the outer vesicle, fig. 10 *a*, is lined throughout with a delicate membrane, *b*; in fact the lips or margins of the saucer-like vesicle have unrolled themselves and now form the upper portion of the lining membrane, the saucer itself being the lower portion of it. And moreover the lining membrane is continued through the neck of the outer vesicle, and is seen to be prolonged into the stalk, *c*, supporting the arrow-head; the barbs, *c'*, of which, three in number, are now very much elevated, being almost horizontal; and thus protruded beyond the surface of the tentacle are ready to lay hold of prey in the manner of a grappling-iron.

The animal would appear, however, to have the power of throwing the whole apparatus from the tentacle. If a specimen be laid on a piece of glass and examined through the microscope, a number of these organs with the barbs fully extended will be

seen scattered about like as many minute Florence flasks; the bulbous extremity being elegantly rounded. For the purpose of ascertaining if the animal really possessed this power, a small worm was given to a polype when under the microscope, and carefully watched. The animal was exceedingly cautious in using its tentacles, not applying them in their whole extent as might have been expected, but keeping by far the greater portion of these organs perfectly free and unattached to its prey. Very few of the arrow-heads were exserted, and apparently never till required; occasionally certain parts of the tentacles were brought into contact with the worm, and then, as it was forcibly drawn further into the mouth, the protruded barbs might be seen sticking in the surface of the struggling victim. At other times, as it rolled about in its vain endeavours to escape, the bulbous extremities of several of these formidable weapons were seen protruding from the skin, undoubtedly placed there by the pungent embrace of this deadly and determined foe; while others lay scattered about in every direction as if just cast from the tentacles. It is therefore evident that these weapons can be used either as grappling instruments for securing food, or having been plunged into some living prey, can be left half-buried in the wound. Indeed when the barbs have been once fairly immersed, it is difficult to conceive how they can be withdrawn; and therefore it is probable that the tentacles can only be disengaged by moulting these organs, which seem to be very slightly attached by the neck of the flask-like portion.

This, however, may not be the only reason why these weapons are left in the wound. It has been stated that they are stinging as well as captor organs, and if so may require time to pour the poison into the wounded animal. The deadly fluid is probably contained in the bulbous portion of the instrument, and by the contraction of its walls may be forced through the other extremity which is perforated; at least from the extreme point a long, delicate filament, fig. 10 *d*, almost invariably protrudes, resembling very closely the appearance of the long process attached to the stinging bodies thrown out of the papillæ of *Eolis*, and from the tentacles of *Actinia*. But other bodies much more closely resembling the stinging organs of these animals were found strewed about associated with the captor organs. These bodies, fig. 11, are minute elliptical sacs with a long, slender filament from one end like that just mentioned from the pointed extremity of the captor organ. The filaments of both these bodies have a double margin, and are apparently tubular. Now it is more than probable that these elliptical sacs are thrown out of the captor organ, and that the filament, so frequently seen

issuing from its pointed extremity, belongs to one of them about to be exserted.

We thus see that *Hydra* is provided with a most efficient stinging apparatus, which having penetrated the surface of its prey remains fixed there, discharging into the wound its poison-bearing filaments. No wonder then that the embrace of these animals should be so deadly to the animalcule that comes within their reach; and that the worm so tenacious of life should fall paralysed from their touch and die, as we are told, almost without a struggle.

The captor organs of *Hydra viridis* are exactly similar to those just described, but are scarcely more than half their size. In this species, too, they are cast from the tentacle.

Corda considers the arrow-head, and what he calls the ovate corpuscle, which we have seen is the membranous stalk supporting the barbs, to be calcareous. Acetic acid, however, has no effect on these parts; and they resist nitric acid for some time, but in the course of an hour or two almost disappear under the influence of this powerful fluid. It is therefore evident that neither of these parts is calcareous: the arrow-head and barbs are probably composed of horny tissue, or some other substance with which we are unacquainted.

It appears that Corda has also determined the existence of an anal outlet at the posterior extremity of the animal. I have likewise seen what I take to be a similar outlet. On examining a specimen in a highly contracted state, and which was about to discharge an egg, a distinct, constricted, linear channel, Pl. VII. fig. 4 *b*, was observed passing from the digestive cavity through the substance of the adhesive disc, apparently about its centre. From this channel issued a long, linear mass, *c*, of excrementitious matter composed of a tenacious mucus imbedding a granular substance resembling both in colour and texture that which lined the digestive cavity.

The true nature of this outlet is enigmatical, since it is known that the refuse of digestion is discharged by the oral orifice. Professor Owen suggests that "it may give passage to certain excretions of the villous lining membrane of the alimentary canal." From the facts just mentioned it would appear that this conjecture is probably correct.

EXPLANATION OF PLATES VI. AND VII.

PLATE VI.

Figs. 1, 2. Two much-enlarged views of the *Hydra* from the Northumberland lakes after development of the sperm-vesicles: *a*, *a*, sperm-vesicles; *b*, ovum in early stage of development.

Figs. 3, 4. Two much-enlarged views of the same before development of the sperm-vesicles.

Fig. 5. Two highly magnified views of the terminal portion of the tentacle, exhibiting nodular enlargements, *a*, and terminal bulb or nodule, *b*.

Fig. 6. Egg after attachment to some foreign body much magnified, exhibiting chorion: *a*, *a*, *a*, a few of the mucus-globules contained in vesicles adhering to the egg.

Fig. 7. A few of the same vesicles containing mucus-globules more highly magnified.

PLATE VII.

Fig. 1. *Hydra* much enlarged, exhibiting development of ova: *a*, basal portion of tentacles; *b*, mouth; *c*, *c*, sperm-vesicles; *d'*, ovum considerably advanced; *d*, ovum just before it bursts through its envelope, *e*.

Fig. 2. Much-enlarged view of egg as it appears immediately after it has burst the envelope: *a*, egg; *b*, *b*, margins of envelope; *c*, *c*, portions of the animal.

Fig. 3. A portion of *Hydra* much magnified, exhibiting the egg when ready to separate from parent: *a*, portion of the animal; *b*, egg; *c*, *c*, mucus-globules as they at first appear; *d*, pedicle attaching egg to parent; *e*, *e*, contracted margins of envelope.

Fig. 4. Enlarged view of *Hydra* much contracted with egg attached, exhibiting anal orifice: *a*, mouth; *b*, anal orifice as seen through the substance of the adhesive disc; *c*, fæces passing out of same; *d*, sperm-vesicle; *e*, egg with undulated margins; *f*, pedicle attaching same to parent; *g*, contracted margin of envelope.

Fig. 5. Sperm-vesicle much enlarged of the *Hydra* from the Northumberland lakes: *a*, gland-like body within the base of same; *b*, apex of same containing spermatozoa; *c*, *c*, a portion of surface of animal.

Fig. 6. Sperm-vesicle much enlarged of *H. viridis*: *a*, gland-like body within base of vesicle; *b*, apex of same containing spermatozoa; *c*, *c*, surface of animal.

Fig. 7. Much-enlarged view of portion of tentacle of the flesh-coloured *Hydra* as seen in the compressor, exhibiting captor organs and organs of touch imbedded in the nodular enlargements: *a*, organs of touch; *b*, captor organs.

Fig. 8. Two of the organs of touch greatly magnified, exhibiting inner and outer vesicles and cilium.

Fig. 9. Greatly enlarged view of retracted captor organ: *a*, outer vesicle; *b*, arrow-head with barbs depressed; *c*, membranous stalk of same; *d*, inner or lining membrane doubled down upon itself.

Fig. 10. Captor organ exserted: *a*, outer vesicle; *b*, inner or lining membrane; *c*, membranous stalk supporting arrow-head with the three barbs, *c'*, elevated; *d*, filament passing out of the pointed extremity of arrow-head.

Fig. 11. Two enlarged views of elliptical sacs with filaments supposed to be poison-organs cast from captor organ.

Fig. 12. Two of the spermatozoa highly magnified from sperm-vesicle of flesh-coloured *Hydra*.